Key Strategies for Estimating Population Sizes

ered: (1) choosing the trap, (2) operating the trap, (3) marking fish, (4) releasing and recapturing marked fish, (5) estimating trap efficiency, (6) assessing trap selectivity, and (7) estimating population size. In this paper, we discuss important aspects of sampling smolts and estimating their population size for small streams and rivers. Examples are drawn from the literature and from recent investigations in Oregon's South Umpqua River basin.

TRAPS

A variety of methods can be used to capture or enumerate smolts, including [redacted] and Stansbury 1991; Cramer et al. 1992). In sit-

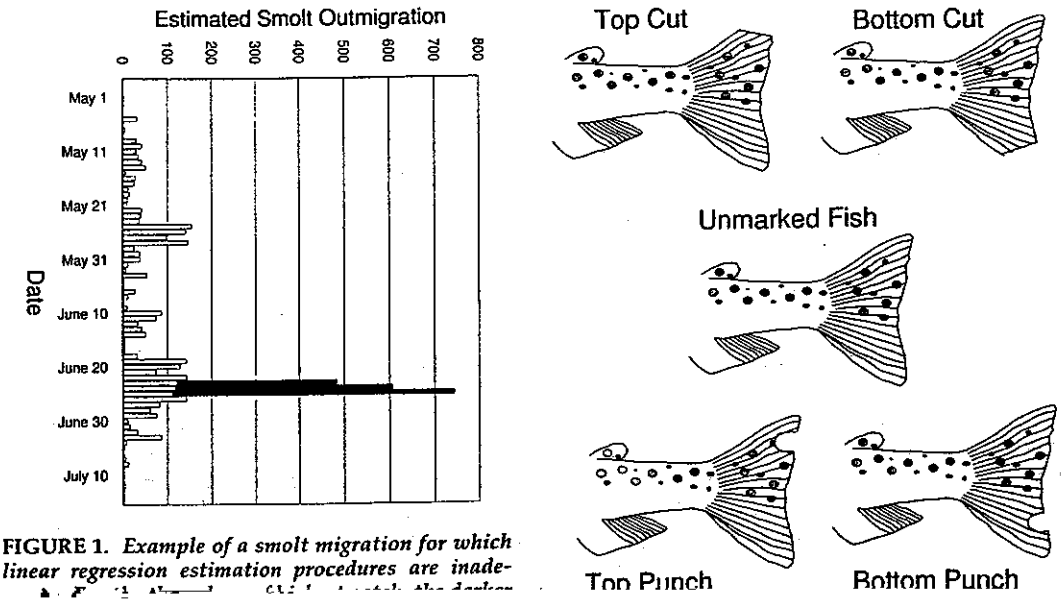


FIGURE 1. *Example of a smolt migration for which linear regression estimation procedures are inade-*

shown to affect fishes. Removal of fins has been shown to reduce the long-term survival [illegible] has been shown to affect fish movements (Hughes 1998).

RELEASE AND RECAPTURE OF MARKED FISH

Regardless of the methods by which smolts are sampled, most population estimates with a single trap rely on capturing fish, marking captured fish, and then transporting them above the trap site and releasing them so that a portion are recaptured as they again move past the trap. This approach allows the estimation of trap efficiency if the marked fish soon move past the trap a second time.

Nonsmolting fish may not be actively migrating, however, and only a small fraction of marked fish may move past the trap a second time. Kruzic (1998) found that less than [illegible] upstream from the trap. The other 10% of the captures exhibited a nearly exponential decline through the following days. Less than 0.05% of the age-0 chinook salmon (*O. tshawytscha*) or age-0 coho salmon in these trials were captured five or more days after release. Only about 2% of the age-1 or older age steelhead (*O. mykiss*) were captured five or more days after release.

To determine if 91.4 m was a sufficient distance for marked fish to have the same capture probability as unmarked fish (and to determine trap avoidance), Seelbach et al. [illegible]

(Ricker 1975; Seelbach et al. 1985; Zafft 1992); where u_j is the trap efficiency for the day when the most fish are recaptured, even

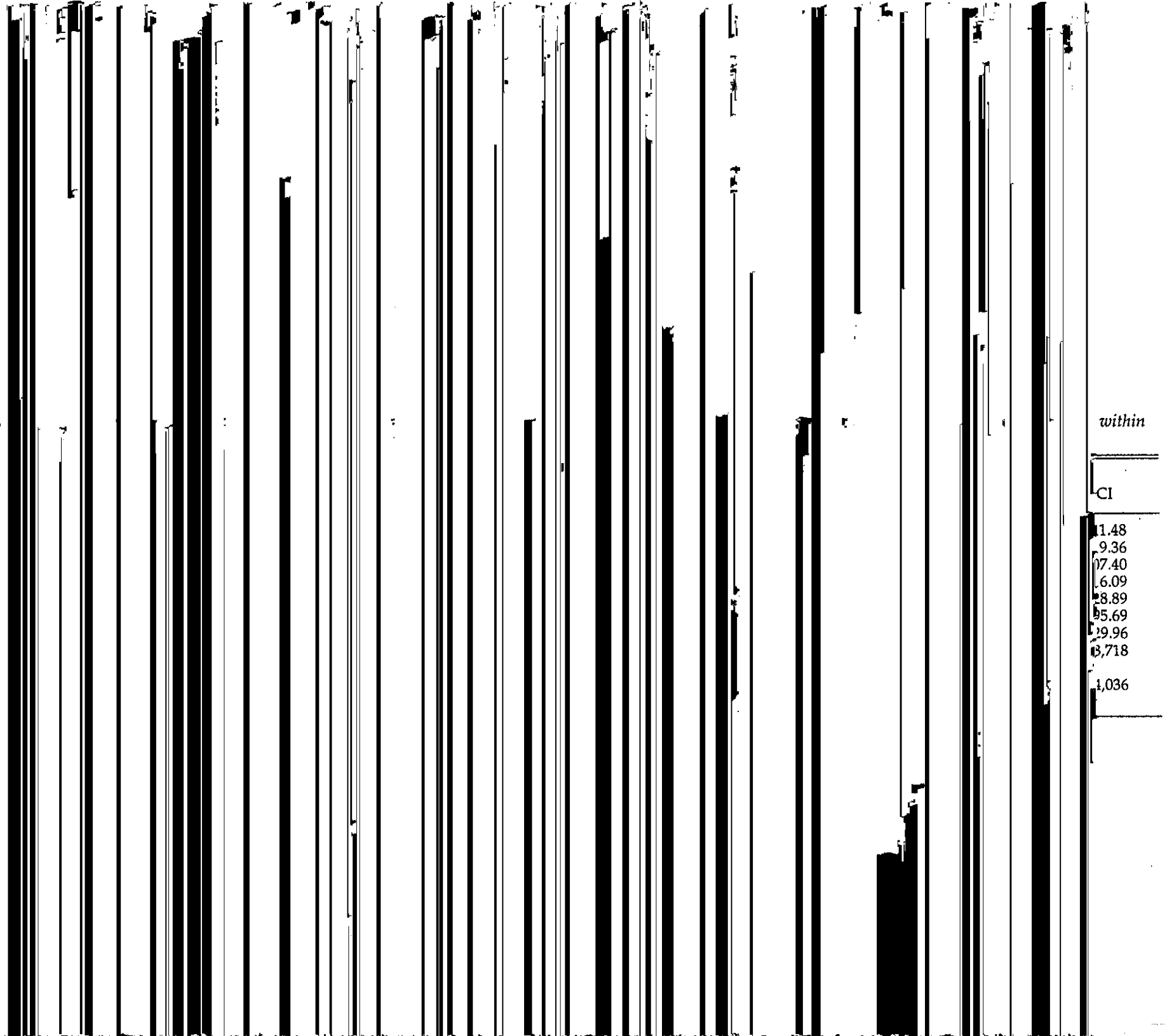
change, however, trap efficiencies can also change (Dambacher 1991, Seelbach 1993). For example, in one instance, higher water may

(n) days, R_{ji} is the number of recaptured fish from the j^{th} release group on the i^{th} day, and M_j is the number of marked fish released. For

pled and may reduce efficiency; in another instance, lower water may allow more fish to detect and avoid the trap, also reducing effi-

example, a group of 100 marked fish (M_j=100)

ciency.


within
CI
1.48
9.36
7.40
6.09
8.89
5.69
9.96
3,718
1,036

for an estimate of trap efficiency is seven or more (Seber 1973), although Ricker (1975)

marked fish during the emigration (Seelbach et al. 1985). In these cases, smolt population

be satisfactory.

gle estimate of trap efficiency, which may or

only weekly or monthly, efficiencies may be estimated by releasing a predetermined num-

annual trap efficiency. If an estimate of trap efficiency is to be made only once during the

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